TITLE OF THE INVENTION

REFRIGERATION APPARATUS AND REFRIGERATOR WITH THE REFRIGERATION APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of Korean Patent Application No. 2003-0090470, filed December 12, 2003, in the Korean Intellectual Property Office, the disclosure of which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present invention relates to a refrigeration apparatus and a refrigerator with the refrigeration apparatus, and in particular, to a refrigeration apparatus and a refrigerator with the refrigeration apparatus having a heat exchange fin with improved structure provided on an evaporator of the refrigeration apparatus.

2. Description of the Related Art

[0003] Generally, a refrigeration apparatus includes a compressor compressing coolant in a vapor state with high pressure and high temperature, a condenser condensing the coolant in the vapor state compressed by the compressor into a liquid state, a capillary tube converting the liquefied coolant into a state of low pressure and low temperature, and an evaporator cooling surrounding air by absorbing latent heat to evaporate the liquefied coolant converted into a state of low pressure and low temperature by the capillary tube.

[0004] The refrigeration apparatus may be used not only in the refrigerator, but also in various heat exchangers such as an air conditioning apparatus.

[0005] Generally a refrigerator includes a main body partitioned into a freezer compartment and a refrigerator compartment, a door covering a front opening of the freezer compartment and the refrigerator compartment, and a refrigeration apparatus cooling the freezer compartment and the refrigerator compartment. Herein, the freezer compartment and the refrigerator compartment can be cooled by circulating the cooled air surrounding the evaporator provided in the refrigeration apparatus into the freezer compartment and the refrigerator compartment.

[0006] FIG. 1 is a cross sectional view of an evaporator provided in a conventional refrigeration apparatus. As shown therein, the evaporator 120 in the conventional refrigeration apparatus has a coolant tube 123 provided to circulate the coolant and a heat exchange fin 130 improving a heat exchange efficiency by coupling with the coolant tube 123. Also, frost is formed on a surface of the coolant tube 123 and heat exchange fin 130 as moisture in the air circulated from an inside of a storage compartment of a refrigerator adheres to the surface of the coolant tube 123 because of a temperature difference of the surface of the coolant tube 123 and the air circulated from the inside of the storage compartment of the refrigerator. The frost decreases the efficiency of the evaporator because it decreases the heat exchange rate. The refrigeration apparatus includes a defrosting apparatus such as a heater to remove the frost that grows on the evaporator 120.

[0007] Several heat exchange fins 130 are provided on the evaporator 120, and are formed with a coolant tube accommodating part 131 coupling with and accommodating the coolant tube 123 on a surface of the heat exchange fins 30. Also, the coolant tube 123 is supported in the refrigerator by a coolant tube supporter 125. Accordingly, the conventional refrigerator only increases heat efficiency by increasing the area of the coolant tube 123 and the heat exchange fins 130.

[0008] However, because the conventional evaporator 120 has a longitudinal direction which is perpendicular to a vertical direction, water drops formed during a defrosting operation implemented by a defrosting apparatus accumulate on a corner part 135 of a lower area of the heat exchange fin 130. Meanwhile, another problem that lowers performance of the evaporator 120 arises because the water drops accumulated on the corner part 135 of the heat exchange fin 130 are frozen again when the coolant circulates after completion of the defrosting operation.

SUMMARY OF THE INVENTION

[0009] Accordingly, it is an aspect of the present invention to provide a refrigeration apparatus and a refrigerator with the refrigeration apparatus improving performance of an evaporator.

[0010] The foregoing and/or other aspects of the present invention are achieved by providing a refrigeration apparatus generating cooling air, including an evaporator having a coolant tube with several bending parts, and heat exchange fins formed with at least one coolant tube accommodating part coupling with the coolant tube. The refrigeration apparatus also includes a defrosting unit adjacent to the evaporator to remove frost formed on the evaporator, each heat exchange fin is inclined at an inclination angle so that a longitudinal direction of the heat exchange fin forms an acute angle relative to a vertical direction to enable the water drops defrosted by the defrosting unit to flow downward to a bottom end of the heat exchange fin, and opposite sides of each heat exchange fin are provided with rounded corner parts.

[0011] According to an aspect of the invention, at least one of the corner parts of each heat exchange fin is rounded to have a radius ranging approximately from 5 mm and 20 mm.

[0012] According to another aspect of the invention, the inclination angle of the heat exchange fin ranges approximately from 50 degree to 75 degree.

[0013] Also, the heat exchange fin has at least one protrusion protruding orthogonally from a surface of the heat exchange.

[0014] In a further aspect of the invention, the heat exchange fins are inclined toward one side relative to a vertical direction, and the bottom end of each heat exchange fin is adjacent to a wall on which the evaporator is installed.

[0015] According to another aspect of the invention, a coolant tube supporter is provided on opposite sides of the evaporator to support the coolant tube.

[0016] In addition, the heat exchange fins have a shape of a rectangular plate, and the coolant tube accommodating parts are formed on a surface of the heat exchange fin in pairs.

[0017] According to another aspect of the present invention, the above and/or other aspects may be also achieved by providing a refrigerator including a refrigeration apparatus described above; a main body formed with at least one storage compartment supplied with cooling air generated by the refrigeration apparatus; and at least one door covering an opening of the storage compartment.

[0018] Additional aspects and advantages of the invention will be set forth in part in the description which follows and, in part, will be obvious from the description, or may be learned by practice of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] These and/or other aspects and advantages of the present invention will become apparent and more readily appreciated from the following description of the aspects, taken in conjunction with the accompany drawings of which:

FIG. 1 is a partial cross-sectional view of a conventional evaporator;

FIG. 2 is a front view of a refrigerator including a refrigeration apparatus according to an embodiment of the present invention;

FIG. 3 is a perspective view of the refrigerator in FIG. 2;

FIG. 4 is a perspective view of the evaporator of the refrigeration apparatus in FIG. 3;

FIG. 5 is a cross sectional view of the evaporator of the refrigeration apparatus in FIG. 3, taken across line V-V; and

FIG. 6 is a front view of a heat exchange fin of the evaporator in the refrigeration apparatus according to an embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0020] Reference will now be made in detail to the aspects of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to like elements throughout. The aspects are described below in order to explain the present invention by referring to the figures.

[0021] As shown in FIGS. 2 and 3, a refrigerator 1 according to an embodiment of the present invention includes a main body 10 having storage compartments such as a freezer compartment 13 and a refrigerator compartment 14, a door 5 covering a front opening of the freezer compartment 13 and the refrigerator compartment 14, a refrigeration apparatus provided on a rear area of the main body 10 and equipped with an evaporator 20 to generate cooling air for cooling the freezer compartment 13 and the refrigerator compartment 14, and a defrosting apparatus 40 to remove frost formed on a surface of the evaporator 20.

[0022] The freezer compartment 13 and the refrigerator compartment 14 of the main body 10 have shelves 15 and compartments 16 to accommodate items such as food. Also, a rear area of the main body 10 is provided with an evaporator accommodating part 18 to accommodate the evaporator 20, and an accommodating part cover 19 provided in front of the evaporator accommodating part 18 and covering the evaporator accommodating part 18.

[0023] The evaporator accommodating part 18 is provided on a rear of the freezer compartment 13. However, the evaporator accommodating part 18 may also be provided on a rear of the refrigerator compartment 14, or on both of the rear areas of the freezer compartment 13 and the refrigerator compartment 14. Also, the evaporator accommodating part 18 includes bosses 18a coupling the evaporator accommodating part 18 to the evaporator 20 and the accommodating part cover 19 by screws.

[0024] As shown in FIG. 4, the refrigeration apparatus has a compressor compressing coolant in a vapor state with high pressure and high temperature, a condenser condensing the coolant compressed by the compressor into liquid, a capillary tube converting the liquefied coolant into a state of low pressure and low temperature, the evaporator 20 cooling surrounding air by absorbing latent heat to evaporate the liquefied coolant converted into a state of low pressure and low temperature by the capillary tube, and a connecting pipe 27 connecting the compressor, the capillary tube, and the evaporator 20 to enable the coolant to circulate. Accordingly, the freezer compartment 13 and the refrigerator compartment 14 can be cooled by circulating the cooled air around the evaporator 20 into the freezer compartment 13 and the refrigerator compartment 14.

[0025] The evaporator has a coolant tube 23 to pass the coolant, and heat exchange fins 30 formed with at least one coolant tube accommodating part 31 to couple with the coolant tube 23, as shown in FIG. 5. Also, the evaporator 20 is provided with a coolant tube supporter 25 on opposite sides of the evaporator 20 to support the coolant tube 23.

[0026] The coolant tube 23 is coupled with the connecting pipe 27 to couple with the compressor and the capillary tube. Also, the coolant tube 23 has bending parts along a vertical direction and inserted into the coolant tube accommodating part 31 of the heat exchange fin 30. Also, the coolant tube 23 has a dual structure in which the coolant tube 23 is bent to form a pair of tube sections in the front and the rear of the heat exchange fins. However, the coolant tube 23 may be provided in different configurations such as a single structure, or a triple structure.

[0027] The coolant tube supporters 25 are provided on opposite sides of the coolant tube 23, respectively, to support a shape of the coolant tube 23. Also, the coolant tube supporter 25 is coupled to the evaporator accommodating part 18 and a screw so that the evaporator 20 can be coupled to the evaporator accommodating part 18.

[0028] FIG. 6 shows the heat exchange fin 30 is provided in a predetermined angle 'a' so that a longitudinal direction of the heat exchange fin 30 forms an acute angle relative to a vertical direction to make defrosted water drops flow to a bottom end 33 of the heat exchange fin. In other words, a longitudinal direction line 'A' of the heat exchange fin 30 and a vertical direction line 'B' along which the water drops falls should form an acute angle 'a'. Further, the acute angle should be between 50 degrees and 75 degrees. However, the angle 'a' formed by the longitudinal direction line 'A' of the heat exchange fin 30 and the vertical direction line 'B' may be between 40 degrees and 50 degrees so that the water drops formed on the heat exchange fin 30 can flow to the bottom end 33 easily. Also, the angle 'a' formed by the longitudinal direction line 'A' of the heat exchange fin 30 and the vertical direction line 'B' may be determined according to a length of the heat exchange fin 30 and a distance between the coolant tubes 23 set along a vertical direction. Further, each heat exchange fin 30 is inclined to one side relative to a vertical direction, and the bottom end 33 of each heat exchange fin 30 is adjacent to a wall where the evaporator 20 is installed. In other words, the bottom end 33 of the heat exchange fin 30 is inclined so that the bottom end 33 is adjacent to an inner wall of the evaporator accommodating part 18. Accordingly, the water drops that flowed along to the bottom end 33 of the heat exchange fin 30 can flow downward along the wall of the evaporator accommodating part 18. Also, a lower area of the evaporator accommodating part 18 may include a discharging hole to discharge the water from the heat exchange fin 30. However, the lower area of the evaporator accommodating part 18 may alternatively be provided with an additional water accommodating part to gather the water drops.

[0029] Also, round corner parts 35 are provided on opposite sides of the heat exchange fin 30. Although the heat exchange fin 30 may have a shape of a thin rectangular plate, it may also have different polygonal shape. Also, a surface of the heat exchange fin 30 may have at least one protrusion 37 protruding orthogonally from the surface of the heat exchange fin 30.

[0030] The bottom end 33 of the heat exchange fin 30 may be in contact with the wall of the evaporator accommodating part 18. Also, an end of the bottom end 33 is formed to be sharp so that the water drops formed on the heat exchange fin 30 flow along toward the wall of the evaporator accommodating part 18 easily.

[0031] The corner parts 35 include left and right areas between a top end 32 and the bottom end 33 of the heat exchange fin 30, and may be rounded so that the water drops formed on a top area of the heat exchange fin 30 flow toward the bottom end 33 easily. Also, the corner part 35 is preferably rounded to form a half circle with a radius between 5 mm and 20 mm. However, the radius may be between 3 mm and 5 mm, or between 20 mm and 50 mm, or over 50 mm according to a size of the heat exchange fin 30, so that the water drops formed on the top area of the heat exchange fin 30 flow toward the bottom end 33 easily.

[0032] The coolant tube accommodating part 31 is formed through a surface of the heat exchange fin 30 to accommodate the coolant tube 23, and may be provided in pairs. However, the coolant tube accommodating part 31 may be provided as a single, or as a triple according to a shape of the coolant tube 23.

[0033] The protrusion 37 functions to prevent the heat exchange fin 30 from being bent easily as it protrudes from the surface of the heat exchange fin 30. Also, the protrusion 37 can improve heat exchange efficiency by causing turbulence in an air flow around the heat exchange fin 30. Although the protrusion 37 may be provided in triplicate on the surface of the heat exchange fin 30, it may also be provided singly, in a pair, or in quadruplet.

[0034] The defrosting apparatus includes a defrosting heater 41 and a heater supporter 43 supporting the defrosting heater 41. Also, the heater supporter 43 is installed on a bottom area of the evaporator accommodating part 18 so that the defrosting heater 41 is positioned on a lower side of the evaporator 20. However, the defrosting apparatus 40 may be provided on a front and a rear of the evaporator 20, and it may include different heating means other than the defrosting heater 41.

[0035] A defrosting process with such a configuration of the evaporator provided in the refrigeration apparatus of a refrigerator according to the embodiment of the present invention is described below.

[0036] First, the compressor provided in the refrigeration apparatus stops operating, and the defrosting heater 41 of the defrosting apparatus 40 is powered on. The water drops are formed as the frost stuck on the coolant tube 23 and the heat exchange fin 30 in the evaporator 20 melts. Also, as the water drops get bigger, the water drops flow toward the bottom end 33 easily along the surface and a rounded edge of the heat exchange fin 30 by the weight of the water drops. Also, the water drops that reach the bottom end 33 keep flowing downward along the wall of the evaporator accommodating part 18 to be discharged easily. In other words, the water drops formed on the heat exchange fin 30 can flow to the bottom end 33 easily without accumulating on the corner part 35 because the heat exchange fin 30 is provided with an inclination and the corner part 35 is rounded.

[0037] Accordingly, the refrigeration apparatus according to an embodiment of the present invention can improve performance of the evaporator by preventing the water drops from being accumulated and frozen on the heat exchange fin and on the coolant tube. Also, the refrigerator installed with such refrigeration apparatus can reduce power consumption as the performance of the refrigerator is improved.

[0038] Although this embodiment of the present invention describes a refrigeration apparatus applied to a refrigerator, such refrigeration apparatus may be applied not only to the refrigerator, but also to various heat exchangers such as an air conditioning apparatus.

[0039] As describe above, the embodiment of the present invention can improve the performance of the evaporator provided in the refrigeration apparatus. Also the refrigerator provided with such refrigeration apparatus can reduce power consumption.

[0040] Although a few embodiments of the present invention have been shown and described, it will be appreciated by those skilled in the art that changes may be made in these aspects without departing from the principles and spirit of the invention, the scope of which is defined in the appended claims and their equivalents.